

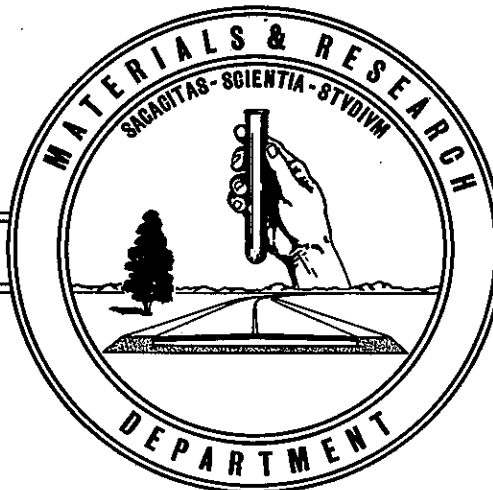
STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS



SECOND PROGRESS REPORT ON
TEST RESULTS ON SAMPLES TAKEN FROM
SEAL COAT TEST SECTIONS ON
ROAD II-Imp-III P.M. 1.2/9.7

68-324

January 1968



State of California
Department of Public Works
Division of Highways
Materials and Research Department

January 18, 1968

M & R Project
19301-762400-33290

Mr. J. Dekema
District Engineer
District 11
Post Office Box 390
San Diego, California

Dear Sir:

Submitted for your consideration is:

SECOND PROGRESS REPORT

ON

TEST RESULTS ON SAMPLES

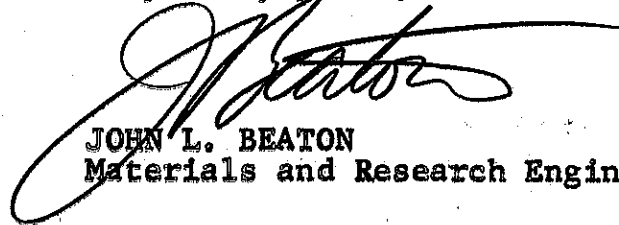
TAKEN FROM SEAL COAT

TEST SECTIONS ON ROAD

11-Imp-111-P.M. 1.2-9.7

Study made by	Pavement Section
Under general direction of	E. Zube
Work supervised by	J. Skog and
	G. Kemp
Report prepared by	G. Kemp and
	N. Predoehl

Very truly yours,



JOHN L. BEATON
Materials and Research Engineer

GK:ss
Attach.
cc: LRGillis
JFJorgensen
ELTinney

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Synopsis

During May, 1966, District 11 Maintenance Department placed experimental seal coat test sections at six locations on Road 11-Imp-111 PM 1.2/9.7. The test sections were placed in order to evaluate the relative merits of a "Reclamite" treatment when compared with an emulsion seal, and a combination Fuel Oil-Diesel Oil treatment. Untreated sections were also left at each location as control sections.

The Materials and Research Department performed tests on cores obtained prior to the treatments, and reported the data in July, 1966. This report gives results of tests obtained from testing cores sampled during September, 1967, and check cores sampled during November, 1967.

The test data indicates that any treatment used was only effective in the upper 1/2 inch layers of the pavement. The asphalt within the pavement below the top 1/2 inch is continuing to weather rapidly and the weathering rate was not affected by the various seals.

Conclusions

The data presented in this report brings out several conclusions in regards to the use of these surface treatments.

1. All surface treatments used were effective in reducing the permeability of the pavement surface to air, and surely, water. The Reclamite treatment appeared to accomplish this to a slightly greater degree.
2. None of the treatments appreciably affected whole core density and were only effective in influencing the top 1/2 inch layer of the pavement.
3. Although the treatments were effective in reducing surface permeability, there was no effect on reducing asphalt oxidation or hardening below the top 1/2 inch layer.
4. The asphalt used in the emulsion seal was apparently of poor durability and hardened at a rapid rate.
5. From the standpoint of the test data presented in this report, it appears the Fuel-Diesel Oil treatment was as effective as the higher priced Reclamite treatment.

Recommendations

Although the Fuel-Diesel Oil treatment was as effective as the Reclamite, we do not recommend its use on a large scale. There are no available specifications for controlling the solvent power of either fuel oil or diesel oil, and different manufacturer's products will almost certainly vary in this important property. A slight excess of this combination could easily lead to excessive softening, and serious raveling, especially in the high temperature areas of the District. We recommend the use of a product like Reclamite or mixing emulsion, if it is desired to check raveling or decrease the water permeability of the pavement. Products of this type are much more uniform, and their effectiveness may be controlled by dilution and/or spread rate.

Test Results and Discussion

The test data discussed here is on cores taken at approximately the same locations as the initial cores. Only three of the six sections initially treated were tested completely. These three sections were representative of all the asphalts and treatments used. The tests performed were the same tests that were performed initially; that is, the stability, cohesion, air permeability, specific gravity (for calculating air voids), percent asphalt, and tests on the recovered asphalt both from the whole core and individual 1/2 inch slices from top to bottom. Results of the various tests are shown on Tables A, B, and C.

Stability

Even though the stabilities shown in Table A are still low from a design standpoint, they have increased to some extent because of increased density.

Cohesion

The cohesion data indicates that the cohesions have increased as the asphalt has hardened and the pavement has become more compacted. This follows the normal trend for this type of data.

Air Permeability and Percent Air Voids

The air permeability decreased considerably in all the sections as a result of further compaction by traffic. It is noted though that the air permeability decreased the least

where no treatment was used. This indicates that a surface treatment will aid in sealing the surface of a pavement to air and water. Due to the fact that the percent air voids are still quite high and that the asphalt has continued to harden rapidly in all of the sections, it would tend to indicate that oxidation is continuing in all of the pavement sections even though the surface is quite air tight.

Extraction Results (% Asphalt)

The difference between the extraction results from this coring and the initial coring is insignificant and indicates that the initial asphalt content results are accurate for the sections.

Recovered Asphalt Test Results

(Absorbed recovered asphalt from large cores)

The test results show that the penetrations on the recovered asphalts from all sections have continued to decrease. In sections I and II the asphalt has now reached a hardness which would indicate that these sections are in possible danger of failure. Sections III and V are also approaching low ductilities. While the penetrations for Sections IV and VI have decreased, it appears that they are in fairly good shape as the asphalt penetration is not at a critical point and the ductilities are still high.

(Recovered asphalt from core slices 1/2 inch thick from 4 inch diameter cores. Micro-recovery method.)

The results of testing the pavement in 1/2 inch slices shows (Table B) that the treatments definitely have an effect on the top 1/2 inch of the pavement. Looking at Figures I, II, and III, they show that this effect caused by the treatment stops by the time it reaches the 5/8 inch to 1-1/8 inch layer. The remaining bottom layers are all virtually alike in their test results as regards the difference between the different treatments. This finding indicates that a surface treatment of any type will not prevent the movement of air through a pavement high in interconnected void space. It appears that future hardening of the binder may be most effectively reduced by adequate compaction during construction.

The different treatments had different effects on the pavement. The treatment which caused the greatest softening was the Fuel and Diesel Oil combination. The Reclamite produced almost the same amount of softening except for Section IV where it caused the greatest softening. The emulsion treatment hardened the surface in two sections and softened it in one section. These sections were recored in the control and emulsion portions and the results (Table C) substantiate the original results. It appears that the asphalt contained in the emulsion had very poor weathering characteristics and hardened excessively causing the emulsion treated sections to be harder at the surface than the control asphalt.

Figures I, II, and III graphically show how each of the three sections are weathering.

TABLE A

Cored September, 1967

Age of Treatment 16 months

CORE SAMPLE TEST RESULTS

Sample Station			Lane	Road 11-Imp-111-1.2-9.6										Seal Coat Test Sections					Recovered Asph Abson Method Pen at Duct at 77°F 77°F cm
Sample No.	Station	Location in Lane		Treatment Used	Core Ht.	Air Perm Mis/Min at 1" Vac	Wax Sp.Gr.	Theo. Max. Sp.Gr.	% Air Voids	Stab. 140°F	Cohes. 140°F	% Asph.							
Section I P.M. 7.00																			
33575	190' South	SB#2	OWT	Emulsion Control	0.28	71	2.22	2.44	9.0										
33576	290' South	SB#2	OWT	Fuel & Diesel Oil	0.28	136	2.20	"	9.9	21	125	4.7	16	25					
33577	390' South	SB#2	OWT	Reclamite	0.27	75	2.22	"	9.0										
33578	490' South	SB#2	OWT	Reclamite	0.27	79	2.20	"	9.9										
Section II P.M. 6.00																			
33579	290' South	SB#2	OWT	Control	0.33	91	2.21	2.44	94			4.7	16	16					
Section III P.M. 5.00																			
33580	190' South	SB#2	OWT	Emulsion Control	0.34	89	2.23	2.46	9.4	25	205	4.2	24	55					
33581	290' South	SB#2	OWT	Fuel & Diesel Oil	0.30	231	2.20	"	10.5										
33582	390' South	SB#2	OWT	Reclamite	0.30	92	2.21	"	10.1										
33583	490' South	SB#2	OWT	Reclamite	0.29	33	2.24	"	8.9										
Section IV P.M. 4.00																			
33584	190' South	SB#2	OWT	Emulsion Control	0.32	30	2.30	2.43	5.3	34	120	5.0	30	100+					
33585	290' South	SB#2	OWT	Fuel & Diesel Oil	0.29	23	2.30	"	5.3										
33586	390' South	SB#2	OWT	Reclamite	0.30	24	2.32	"	4.5										
33587	490' South	SB#2	OWT	Reclamite	0.30	21	2.31	"	4.9										
Section V P.M. 3.00																			
33588	290' South	SB#2	OWT	Control	0.29	27	2.25	2.45	8.1			4.8	20	35					
Section VI P.M. 2.00																			
33589	290' South	SB#2	OWT	Control	0.28	36	2.27	2.43	6.6			5.0	28	81					

TABLE B

Cored September, 1967
Age of Treatment 16 months
CORE SAMPLE TEST RESULTS

Road 11-Imp-111-1.2-9.6 Seal Coat Test Sections
Test Results on Recovered Asphalt

Sample No	Station	Lane	Location in Lane	Treatment Used	Recovered Asphalt Test Results (Slices)											
					Top 0" - 1/2"			5/8" - 1-1/8"			1-1/4" - 1-3/4"			1-7/8" - 2-3/8"		
					Viscosity	Micro Duct	MM	Viscosity	Micro Duct	MM	Viscosity	Micro Duct	MM	Viscosity	Micro Duct	MM
					.05	.001		.05	.001		.05	.001		.05	.001	
Section I P.M. 7.00																
33575	190' South	SB#2	OWT	Emulsion Control	147.0	970.0	0	100.0	318.0	0	63.0	340.0	1	33.0	111.0	4
33576	290' South	SB#2	OWT	Fuel & Diesel Oil	95.0	450.0	1	86.0	305.0	0	69.0	217.0	2	34.6	120.0	2
33577	390' South	SB#2	OWT	Reclamite	26.5	108.0	0	100.0	276.0	3	84.0	273.0	1	40.0	127.0	2
33578	490' South	SB#2	OWT		60.5	245.0	1	112.0	330.0	0	78.0	275.0	0	48.0	132.0	3
Section III P.M. 5.00																
33580	190' South	SB#2	OWT	Emulsion Control	245.0	1070.0	0	152.0	490.0	1	112.0	550.0	1	55.0	152.0	0
33581	290' South	SB#2	OWT	Fuel & Diesel Oil	105.0	500.0	0	105.0	420.0	1	90.0	390.0	0	50.0	220.0	1
33582	390' South	SB#2	OWT	Reclamite	28.7	118.0	3	108.0	410.0	1	89.0	430.0	0	47.0	205.0	1
33583	490' South	SB#2	OWT		38.0	142.0	2	158.0	540.0	0	120.0	420.0	1	52.0	205.0	1
Section IV P.M. 4.00																
33584	190' South	SB#2	OWT	Emulsion Control	45.0	152.0	2	43.5	148.0	5	32.5	67.0	12	36.0	45.0	8
33585	290' South	SB#2	OWT	Fuel & Diesel Oil	30.5	82.0	4	34.5	91.0	5	29.0	46.0	43	34.0	45.5	3
33586	390' South	SB#2	OWT	Reclamite	12.5	22.0	9	35.0	68.0	7	39.5	82.0	7	27.5	38.5	62
33587	490' South	SB#2	OWT		8.2	16.1	17	32.0	72.0	7	32.0	72.0	8	53.5	80.0	0

TABLE C

Cored November, 1967

Age of Treatment 18 months

CORE SAMPLE TEST RESULTS

Road 11-Imp-111-1.2-9.6 Seal Coat Test Sections
Test Results on Recovered Asphalt

Sample No.	Station	Lane	Location in Lane	Treatment Used	Top 0" - 1 1/2"		
					Viscosity Megapoise	Micro Duct	MM
					.05	.001	
Section I P.M. 7.00							
34024	90' South	SB#2	OWT	Control #1 Emulsion Control #2	240.0	770.0	0
34020	190' South	SB#2	OWT		165.0	970.0	0
34025	290' South	SB#2	OWT		197.0	630.0	0
Section III P.M. 5.00							
34026	90' South	SB#2	OWT	Control #1 Emulsion Control #2	137.0	610.0	0
34019	190' South	SB#2	OWT		162.0	860.0	0
34023	290' South	SB#2	OWT		83.5	570.0	0
Section IV P.M. 4.00							
34022	90' South	SB#2	OWT	Control #1 Emulsion Control #2	27.7	85.0	1
34021	190' South	SB#2	OWT		40.0	180.0	1
34027	290' South	SB#2	OWT		29.5	80.0	0

FIGURE 1

ASPHALT VISCOSITY CORE DEPTH RELATIONSHIP

SECTION I PM. 7.00

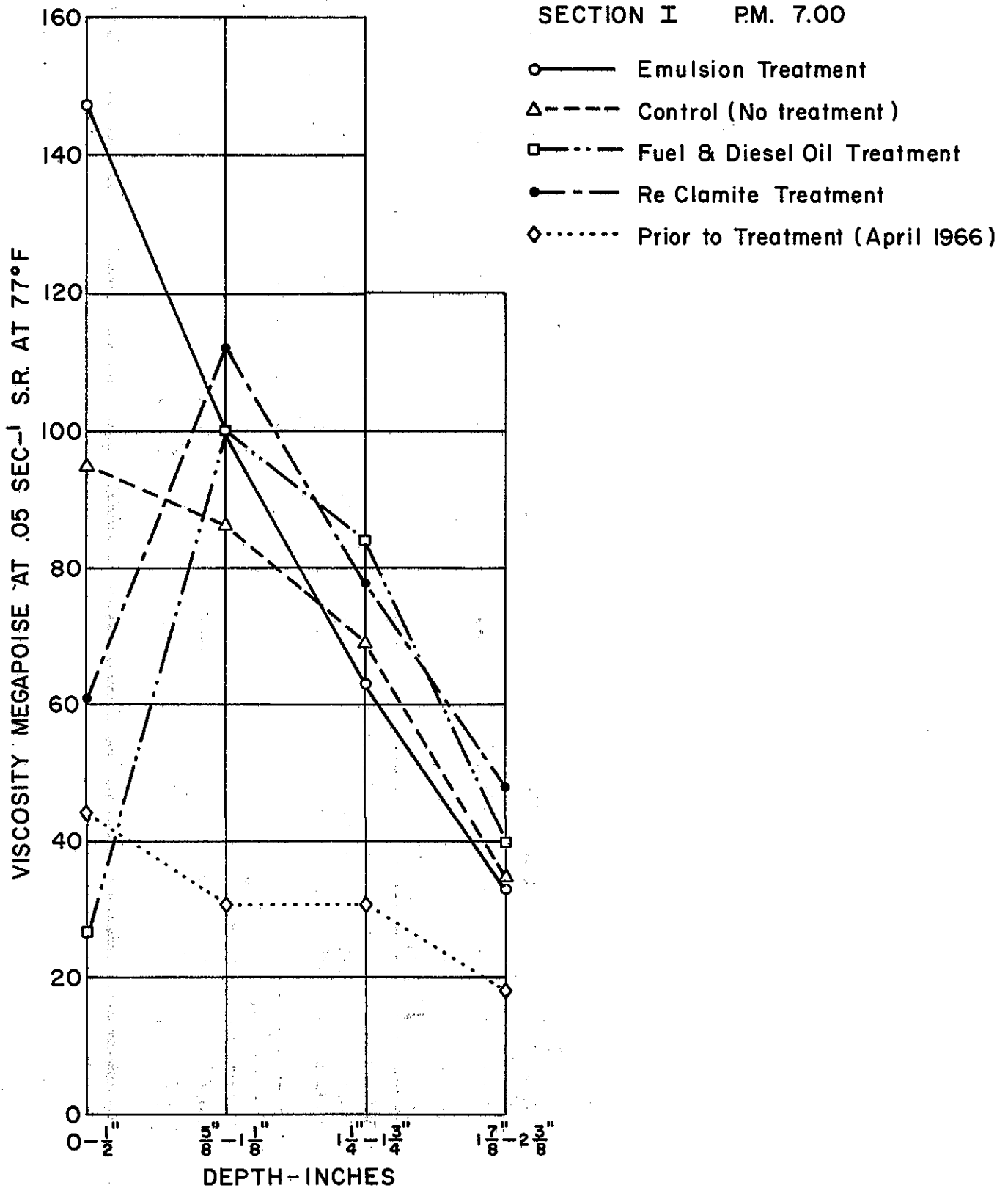


FIGURE 2

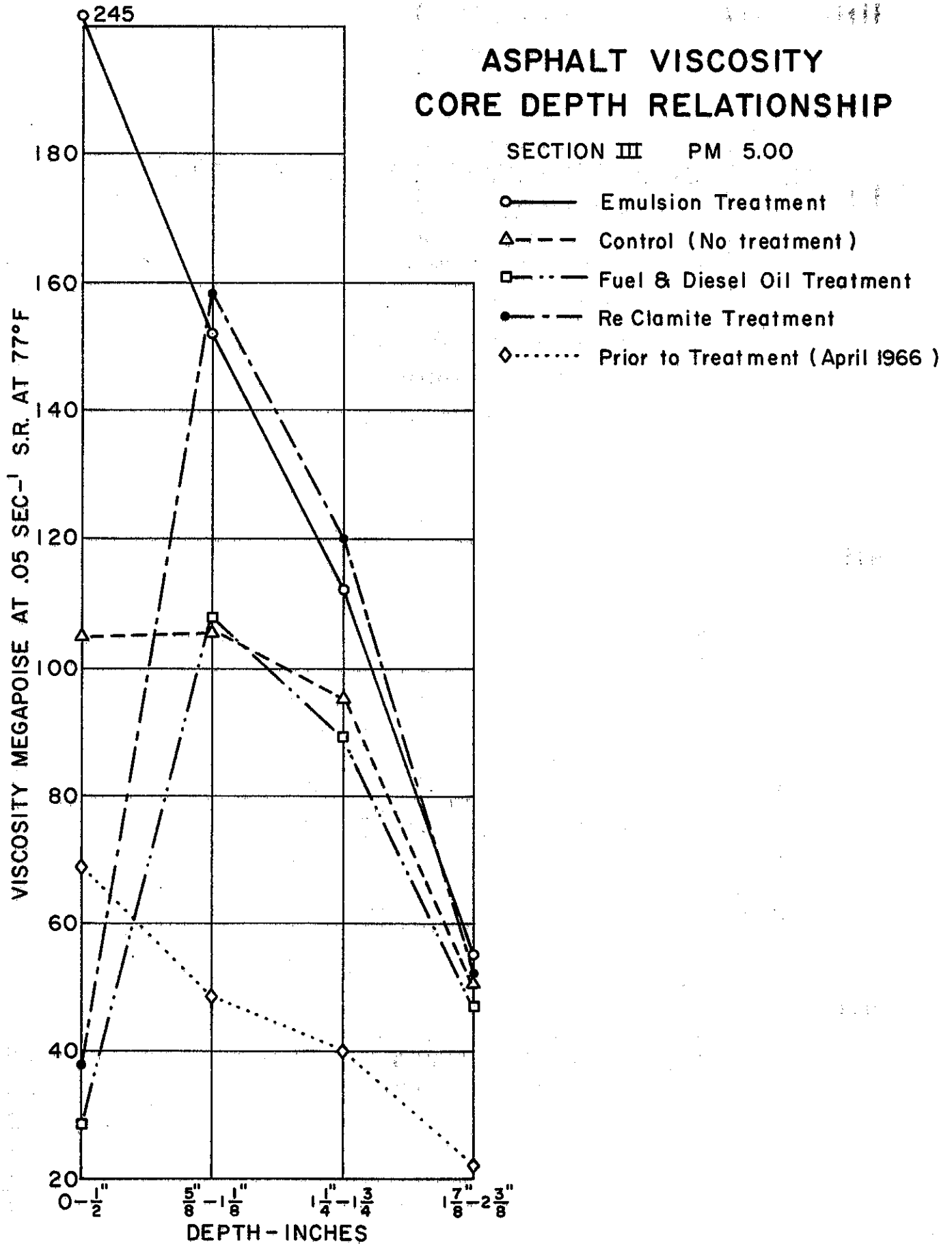


FIGURE 3

ASPHALT VISCOSITY - CORE DEPTH RELATIONSHIP

SECTION IV PM 4.00

- Emulsion Treatment
- △--- Control (No treatment)
- Fuel & Diesel Oil Treatment
- ReClamite Treatment
- ◇..... Prior to Treatment (April 1966)

